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Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W., Room 222
Washington, D.C. 20554

RE: Notice of _Ex Parte_ Contact
PP Docket No. 93-253

Dear Mr. Caton:

Pursuant to Section 1.1206 of the Commission's Rules, notice is hereby given of an _ex parte_ communication regarding the above-referenced proceeding. The instant notice is being submitted in duplicate.

Several questions were raised at the July 7, 1994 American Enterprise Institute Telecommunications Summit Conference concerning the competitive bidding process and how specific bidding procedures would affect the narrowband PCS auction. Peter Crampton, Associate Professor of Economics at the University of Maryland, has prepared an analysis of two issues raised at the Conference. They are entitled "Adjusting the Bid Increments in the Nationwide Narrowband PCS Auction" dated July 9, 1994 and "Comments on the Narrowband PCS Response Channel Auction" dated July 2, 1994. Those papers were given to a member of the Commission Staff by Professor Crampton at the Conference.

Please associate this material with the record in this proceeding on behalf of Paging Network, Inc.

Sincerely,

REED SMITH SHAW & McCLAY

John W. Hunter

John W. Hunter

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Enclosure
cc: Evan Kwerel, Office of Planning and Policy

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Comments on the Narrowband PCS Response Channel Auction

Peter Cramton, 2 July 1994

Problems with the Proposed Auction Design for the 12.5 kHz Response Channels

The use of a sealed bid auction for the 12.5 kHz response channel licenses has several shortcomings: (1) the bidding strategies are unnecessarily complex, (2) no information gets revealed in the auction process, (3) bidders cannot adequately express demands for multiple licenses, (4) the efficient aggregation of licenses across geographic areas is discouraged, and (5) it is virtually impossible to purchase the same frequency across areas. As a result of these shortcomings, the auction outcome is likely to be inefficient.

The Third Report, at 22, identifies simplicity as the principal advantage of the sealed bid auction. Despite its simple rules, the sealed bid auction imposes a burden on firms to develop complex strategies. Firms must try to estimate what the fifth highest bid will be and then bid slightly above it. This is an enormously difficult calculation, since it involves estimating the valuations of all competitors. It is certainly possible that some bidders with high values will guess incorrectly and they will fail to get a license. The complexity is magnified for bidders attempting to aggregate many licenses.

One reason for the complexity is that no information is revealed in the auction process. This prevents bidders from revising their bids in light of new information. It also reduces government revenues, since the winner's curse is more severe with greater uncertainty.

With the proposed sealed bid auction, a bidder cannot express differing values based on the number of licenses won in an area. A firm may value its first license in an area much more or less than its second. The proposed sealed bid auction does not permit a bidder to express these value differences.

The plan strongly discourages efficient license aggregations in two ways. First, the plan makes it impossible for a bidder to purchase the same response channel across regions. Second, the plan makes it unlikely that a firm will be able to purchase all the licenses it desires for an efficient aggregation. The firm is likely to end up with holes in its aggregation because of unexpectedly high bids on a few licenses. With a sealed bid auction, the firm does not have the opportunity to respond to these high bids.

The FCC's arguments for using the sealed bid auction in this context are: (1) the licenses are of low value relative to the cost of conducting more complex auctions, (2) the possibility of collusion among few bidders is reduced with a sealed bid auction, (3) the need for revealing information in the auction is less, because of information revealed in prior auctions. (See Third Report at 29.) However, there is little reason to think that the license values will be low. Acquiring these licenses is the only way incumbent firms can get response channels for two-way paging services. In addition, there is little reason to think that the number of bidders will be small. Many bidders are eligible for the MTA licenses and more densely populated BTA licenses. Bidding activity then is likely to be intense, making collusion unlikely. Finally, information revealed in the prior auctions is not directly applicable to the response channel auction. The earlier auctions involve a different set of bidders, bidding on different types of licenses. Moreover, information from the earlier auctions is of little help to bidders hoping to build efficient aggregations.

Advantages of an Oral Sequential Auction

An oral sequential auction would reduce or eliminate many of the problems discussed above. Although it does not offer as much flexibility as the simultaneous multiple round auction, an oral sequential auction does give bidders the opportunity to react to a great deal of information. Further, an oral sequential auction is not significantly more costly to administer than a sealed bid auction, and from a bidder's perspective it is simpler. Much of the gaming inherent in the sealed bid auction is unnecessary in the oral auction.

Auction Procedures for the MTA Response Channels

We recommend the following auction procedures for the MTA response channel licenses. The design is similar to the oral sequential auction to be used for the IVDS MSA licenses.

1. The MTA licenses are sold in a sequence of 51 open outcry auctions. The order of the auctions is from largest to smallest MTA. The auctions are conducted over two days, as in Table 1. More time is given for the early, more valuable, MTAs.

2. In each open outcry auction, the four licenses (A, B, C, and D) within the MTA are auctioned *simultaneously*. The auctioneer displays the four high bids and bidder numbers, as well as the minimum bids.

3. To bid, a bidder raises a bidding card and shouts out the license and amount ("C for $x") or just the license ("D"), implying the minimum bid on D. An outcry of "A and B" makes the bidder the high bidder on A and B at the minimum bid. A bidder can be the high bidder on up to two licenses.

4. Bid increments are adjusted by the auctioneer at its sole discretion.

5. The bidding stops when bidding activity ceases on all licenses and the auctioneer declares the auction closed. The four high bidders then sign a High Bid Acknowledgment Form and submit an upfront payment.

A key element of the above design is the simultaneous sale of all licenses within an MTA using channel specific bids. This gives the bidders maximum flexibility in expressing values for multiple channels, adjacent channels, or particular channels. Bidders may value a second license more or less than the first, they may prefer adjacent channels, and they may value having the same channel across an aggregation of MTAs. This design allows bidders to express these valuations in a simple and transparent way. As a result, auction efficiency and government revenues are enhanced.

An alternative would be to make the bids non-channel-specific, as is done in the IVDS auction. In this case, the four high bidders would win and they would select channels in the order of their high bids. This method is inferior for two reasons. First, it prevents bidders from directly expressing values for adjacent or particular channels. Second, bidding strategies become much more complex, since to evaluate the premium for first, second, or third choice bidders must guess what channel selections the other high bidders would make. With non-channel-specific bids, conducting the auction is slightly easier for the auctioneer; however, it is much more difficult for the bidders. This alternative should be rejected. It is less efficient and yields lower revenues.

Using the oral sequential auction for the MTA response channels is consistent with the FCC's design philosophy expressed in the Second and Third Reports. The oral sequential auction offers many of the advantages of the simultaneous multiple round auction with lower operational cost. The single round sealed bid auction proposed by the FCC is inconsistent with the FCC's design philosophy, when one makes realistic assumptions about the value of the response channels, the extent of value interdependencies, and the operational cost savings from a sealed bid design. The MTA response channels are of substantial value, there are significant value interdependencies, and the cost savings of the sealed bid auction are dwarfed by the loss in government revenues.

Congress directed the FCC to "design and test multiple alternative methodologies under appropriate circumstances." 47 U.S.C. § 309(j)(3) (See Second Report at 115.) However, the use of a sealed bid auction is *not* appropriate for the MTA response channels. Little would be learned from such an experiment. Indeed, the FCC already intends to test single round sealed bidding in the IVDS auction for RSA licenses. The added value from an additional test with the response channels is negligible.

In contrast, the use of the proposed oral sequential auction would have enormous experimental value. Should the simultaneous multiple round auction have unforeseen problems, the oral sequential auction would be a natural alternative. In this event, the FCC might consider using oral sequential auctions for broadband PCS. The FCC's experience with this auction form for the response channels would be of great value. The experiment is especially relevant, since the four 12.5 kHz response channels within an MTA are analogous to the four 30 MHz bands or four 10 MHz bands within an MTA in broadband PCS.

Auction Procedures for the BTA Response Channels

The case for sealed bid auctions is stronger for the BTA licenses, since they are worth much less than the MTA licenses and there are fewer eligible bidders. Nonetheless, even for

BTA licenses, the oral sequential form is preferred in some cases. In particular, the licenses in more densely populated BTAs are apt to have substantial value and many bidders are eligible to bid. On balance, we recommend that the oral sequential auction be used for BTA licenses.

The BTA auction would follow the same procedures as the MTA auction with the following modifications:

1. The BTA licenses are sold in a sequence of 492 open outcry auctions. The BTA licenses are grouped by MTAs. In each bidding session, all BTAs within a given MTA are auctioned in sequence from largest to smallest. This is a natural grouping given the importance of MTAs in defining geographic markets for PCS. It also fosters an MTA aggregation of BTAs. The bidding sessions are conducted from largest to smallest MTA as in Table 1. The 492 auctions are conducted over four days (about 5 minutes per BTA).

2. In each open outcry auction, the four licenses (E, F, G, and H) within the BTA are auctioned simultaneously, using channel specific bids.

Some less populated BTAs may have only a few eligible bidders. For these BTAs, a sealed bid auction could be used. However, the gain from doing so is small at best. Switching auction forms based on the number of bidders in a BTA is likely to have higher administrative costs (as well as higher costs to the bidders) than simply sticking with the oral sequential auction. The oral auction should proceed quickly with few bidders and low values. Moreover, the concern about collusion in this case is misguided. While it is true that collusion is easier with few bidders, the gain from colluding in this case is small. A firm would not risk disqualification from all FCC auctions as well as criminal penalties to save a few dollars on a less densely populated BTA response channel license.

Table 1. A Sample Two-Day MTA Response Channel Auction Schedule

Time	MTA	% of Mhz-Pops Allocated
8 am	New York Los Angeles San Francisco	23
11 am	Chicago Detroit Charlotte Boston	20
2 pm	Philadelphia Washington Atlanta Minneapolis Tampa	14
4 pm	Miami Houston New Orleans Cleveland Cincinnati St. Louis	12
8 am	Milwaukee Pittsburgh Denver Seattle Richmond Phoenix Louisville Memphis	12
11 am	Birmingham Portland San Antonio Indianapolis Des Moines Kansas City Buffalo Salt Lake City	10
2 pm	Jacksonville El Paso Columbus Little Rock Oklahoma City Spokane Nashville Knoxville	7
4 pm	Omaha Honolulu Wichita Tulsa Alaska Puerto Rico Guam American Samoa	3

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Adjusting the Bid Increment in the Nationwide Narrowband PCS Auction

Peter Cramton, 9 July 1994

A critical element of the simultaneous multiple round auction is the bid increment. With proper adjustment of the bid increment, the auction will come to a timely closure and yet allow bidders to express small differences in valuations. Without proper adjustment, the auction will not close in a reasonable amount of time or it will share the undesirable properties of a single sealed bid auction. In what follows, I propose a method for adjusting the bid increment in the nationwide narrowband PCS auction. The method has been designed and tested using a detailed simulation of the nationwide auction.

The simultaneous multiple round auction is most similar to an English auction. In an English auction, the auctioneer plays a key role in adjusting the bid increment throughout the auction. With a simultaneous multiple round auction, adjustment of the bid increment is even more important for two reasons. First, there is a significant amount of time between rounds (say, an hour), rather than a few seconds as in an English auction. Adopting a pace that is too slow would add days to the auction, rather than minutes. Second, because there are many items for sale in the simultaneous multiple round auction, many more rounds are needed to reach closure than in an English auction for a single item. As bid activity falls, it becomes more likely that it will take several rounds for the price of a particular type of license to increase by a single bid increment.

The importance of the bid increment stems from the fact that it is unlikely that bidders will bid much above the minimum bids in any round. As in an English auction, there is little reason to raise a bid by much more than the bid increment. Doing so needlessly exposes the bidder to the risk of leaving money on the table. A bidder knows that if its bid is not the highest in this round it will have an opportunity to bid again in subsequent rounds. Given the great uncertainty about when bidders are likely to drop out, bidding near the minimum bid is a prudent strategy. This strategy has been recommended by several auction experts.

Of course, a bidder could bid well above the minimum bids in an effort to hasten the auction. But this individual action is unlikely to be effective. Other bidders will simply shift to the other licenses and continue with the minimum increments. The bidder could place a high bid on all licenses, thereby forcing a rapid pace. But this strategy involves enormous risk (the possibility of substantial withdrawal penalties) for little gain (a more timely closure and a reduced risk of a declared final round). Moreover, there is a free-rider problem. Every bidder has the incentive to let the other bidders take the risk of overbidding. Timely closure is unlikely to be assured by the aggressive behavior of individual bidders.

A timely closure under the current plan is unlikely.

The FCC's current plan is to use a bid increment of the greater of $.01 per MHz-pop or 5% of the prior high bid. NABER and PCIA proposed doubling the increment in the early rounds ($.02 per MHz-pop) and then halving the increment in the later rounds (2.5% in stage

2). Based on a simulation of the nationwide auction, I have estimated the number of rounds to close as a function of the final sale price of a 50/50 license. The simulation assumes the NABER-PCIA plan: an increment of the greater of $.02 per MHz-pop or 5% in stage 1 and $.01 per MHz-pop or 2.5% in stage 2. Stage 2 starts when there are fewer than 10 new bids or waivers in the prior round. With the FCC proposal (the greater of $.01 or 5%), the number of rounds would be similar, since it has a slower initial pace, but faster pace at the end of the auction. I assume bidders adopt the conservative strategy of bidding near the minimum bid on the licenses that represent the best value, given the bidders' preferences.

I have conducted 1315 simulations with various parameters. I vary the amount of common and private uncertainty, the number of bidders, as well as other valuation parameters. Figure 1 shows a plot of the number of rounds in each stage as a function of the final price of a 50/50 license. The range of final prices for a 50/50 kHz license ($10 million to $90 million) was chosen *arbitrarily*, without any knowledge of bidder values. It is impossible to predict what the final price will be — the auction price may be less than $10 million or more than $90 million. Nonetheless, it is possible to draw several conclusions from the simulations:

- The number of rounds depends mostly on the final price. A doubling of prices increases the number of rounds by 21.
- There is great variation in the number of stage 2 rounds. This is because with few bidders it may take several rounds for prices to increase by the bid increment.
- If the final sale price is above $20 million, it is likely that more than 60 rounds will be needed to reach closure. In 1,284 out of 1,315 cases (97.6%), more than 60 rounds were needed. Even with a final price between $10 million and $20 million, there is a significant chance that more than 60 rounds will be needed.

By extending the hours of bidding and shorting the time between rounds in the first stage to 45 minutes, it is possible to conduct about 60 rounds in the five days scheduled for the nationwide auction. However, it is unlikely that 60 rounds will be sufficient, unless prices are below $10 million or bid increments are adjusted during the auction. Under the current plan, there is a significant risk that additional time will be needed for the auction to reach a natural end.

Principles of Bid Increment Adjustment

There are five basic principles for an effective method of adjusting the bid increment:

1. ***Start large.*** It is best to have a large bid increment early, when there are many bidders. A large increment quickly brings the price level to a point where bidders start to drop out. In the early rounds, bidding activity is great and there is no cost to a large increment. The large increment simply saves valuable rounds — rounds that are better used at the end of the auction.

2. ***End small.*** Toward the end of the auction, the bid increment should be small, allowing the bidders to express small differences in valuations. A small increment increases efficiency and government revenues. It reduces the importance of gaming and strategy.

3. ***Reduce the increment as bidding activity falls.*** As bidding activity drops the bid increment should fall. The best way to measure bidding activity is the number of new bids in the prior round across all licenses. This is a better measure than the number of new *high* bids, since it is possible for there to be great activity with all the activity concentrated on a single license. This would happen if a particular license was relatively underpriced. Since the licenses are substitutes, it is important to use the same bid increment (adjusting for the size of the license) across all licenses. Waivers should not be counted as new bids, since a waiver does not indicate a willingness to raise prices. Indeed, waivers may be used by bidders who are unwilling to bid under the current bid increment, but who are hopeful that the increment will fall in subsequent rounds.

4. ***Avoid large drops in the bid increment.*** The bid increment should decline gradually with bidding activity. Large drops (say, dropping from 10% to 5% when activity falls below a particular level) introduce more complex strategies. For example, bidders may use waivers strategically, anticipating a large drop in the increment. Faced with a large drop in the increment, bidders are more apt to regret a prior bid.

5. ***Adopt and announce a plan for bid increment adjustment.*** The FCC should adopt and announce a plan for adjusting the bid increment before the auction begins. By adopting a sensible plan up front, the FCC can focus on other things during the auction. Some modifications may be needed as the auction proceeds, but these changes would be minor relative to the changes needed under the current plan. With the current plan, the FCC's behavior is more apt to be viewed as arbitrary. The prior announcement of the plan allows the bidders to develop bidding strategies in light of specific rules. Bidding is more apt to be orderly and rational. As a result, efficiency improves.

A Simple Method for Bid Increment Adjustment

Consistent with the principles above, I propose the following method for adjusting the bid increment. The increment in any round depends on the number of new bids in the prior round. If there are more than 32 new bids in the prior round, the bid increment is the greater of $.064 per MHz-pop or 16% of the prior high bid. If there are less than 8 new bids in the prior round, the bid increment is the greater of $.016 per MHz-pop or 4% of the prior high bid. As the number of new bids falls from 32 to 8, the bid increment falls linearly from 16% to 4% ($.064 to $.016 per MHz-pop), dropping .5% ($.002 per MHz-pop) with each fewer bid. Table 1 shows how the bid increment changes with the number of new bids in the prior round.

Table 1. Bid increment as a function of the number of new bids in prior round.

Number of new bids in prior round	≤8	12	16	20	24	28	≥32
Percentage bid increment	4%	6%	8%	10%	12%	14%	16%
Absolute bid increment ($ per MHz-pop)	0.016	0.024	0.032	0.040	0.048	0.056	0.064
Absolute increment on 50/50 kHz license ($k)	400	600	800	1,000	1,200	1,400	1,600
Absolute increment on 50/12.5 kHz license ($k)	250	375	500	625	750	875	1,000
Absolute increment on 50 kHz license ($k)	200	300	400	500	600	700	800

This bid increment approach accomplishes the five goals above. The bid increment is large initially and declines gradually as bid activity lessens. It is simple and responsive. If bidding activity is slight in the initial round, the increment immediately drops to an appropriate level in the next round. For example, if no firms are willing to bid the minimum bids in the initial round (every firm submitted a waiver), then the bid increment and the minimum bid drops to $.016 per MHz-pop.

To evaluate this method, I have conducted 1185 auction simulations. The simulation parameters, other than the bid increment, are identical to those in the prior simulations. Figure 2 shows the number of rounds in each stage of the auction as a function of the final sale price of a 50/50 kHz license. Stage 2, with the heightened activity rule, begins when the number of new bids in the prior round falls below 10. Several conclusions can be drawn from the simulations:

- The number of rounds is much less sensitive to the final prices. About seven additional rounds are needed with each doubling of prices. This is three times faster than under the FCC's plan, where a doubling of prices requires an additional 21 rounds.
- The total number of rounds is likely to be under 60 rounds even if the final prices are high. In only 11 cases out of 1185 (0.9%) were more than 60 rounds needed. With this method, closure within five days is nearly assured.

A further advantage of this method is that the FCC can make minor adjustments to the plan in response to unforeseen difficulties. Although adjustments are unlikely to be necessary, the FCC may find that after 40 rounds bidding activity is still high. In this case, the FCC can announce that the bid increment will not fall below 6%; that is, it will reach its minimum when the number of new bids in the prior round has fallen to 12, rather than 8. Likewise, the

FCC might find that bidding activity is slight after only 15 rounds. In this case, the FCC can announce that the bid increment will continue to fall to 2% when there are four new bids in the prior round. In this way, bidders will be able to express smaller differences in value, if there is sufficient time.

This method depends on just two parameters: an activity level upper bound (32), that defines the maximum bid increment, and an activity level lower bound (8), that defines the minimum bid increment. For all activity levels between these upper and lower bounds, the percentage bid increment is n/2 and the absolute increment is $.002·n, where n is the number of new bids in the prior round. I have chosen the upper and lower bounds so that it extremely likely that closure will be reached within 60 rounds. Figure 3 shows the number of rounds until closure based on an upper bound of 30 (15%) and a lower bound of 5 (2.5%). With these settings although it is likely that the auction would end within 60 rounds, there is a significant chance that more than 60 rounds would be needed. In 111 cases out of 866 (12.8%), more than 60 rounds were needed. Either the upper or lower bounds should be raised. Figure 4 shows the number of rounds with an upper bound of 40 (20%) and a lower bound of 6 (3%). These settings also seem about right: it is extremely likely that closure is reached within 60 rounds. In only 56 cases out of 1,248 (4.5%), more than 60 rounds were needed.

I have not yet extended this method to auctions for regional, MTA, or BTA licenses. I intend to do this in the near future. There are two potential difficulties.

- Different licenses may have substantially different values in terms of MHz-pops, because of different population densities. Then setting the absolute increment equal across all licenses does not make sense. One way to resolve this problem is to assume that values are proportional to population density. If the absolute increment for the New York MTA is $.04 per MHz-pop, then set the absolute increment for the Spokane MTA = $.04·(pop density Spokane)/(pop density NY). An alternative solution is to allow a bidder to bid below the minimum increment. Such a bid would be valid if and only if no bidder bid at or above the minimum increment. Otherwise, the bidder would need to use a waiver to continue participation.
- It is not immediately obvious what the best measure of bidding activity is.

Neither of these difficulties is present in the nationwide narrowband auction.

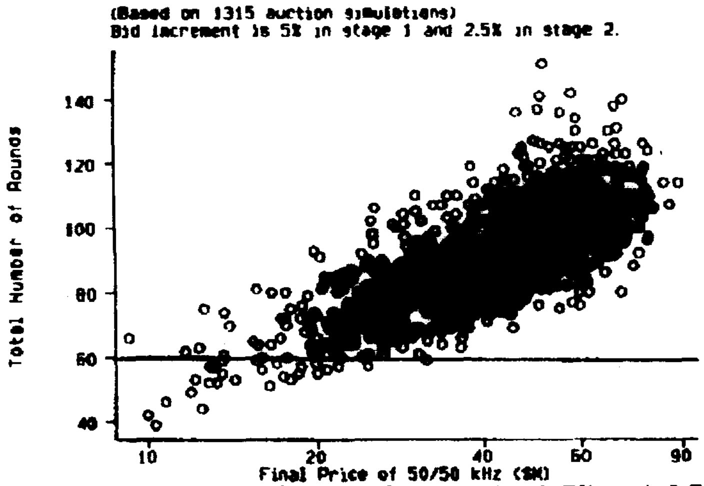

Figure 1. Number of Rounds; Increment of 5% and 2.5%

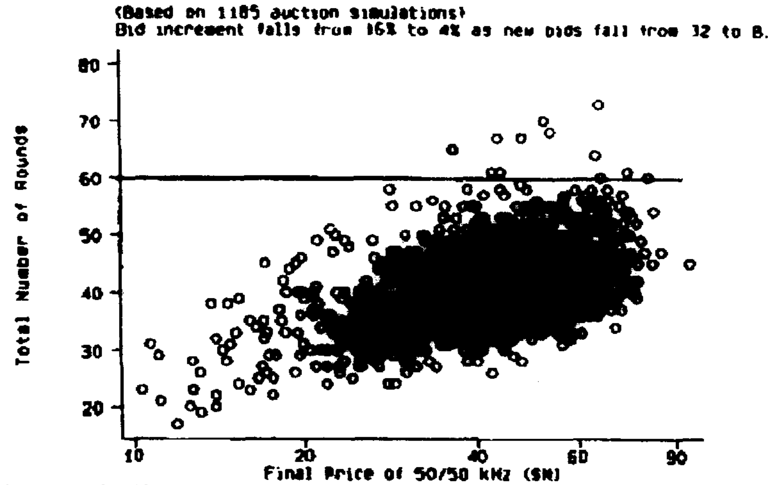

Figure 2. Number of Rounds; Increment from 16% to 4%

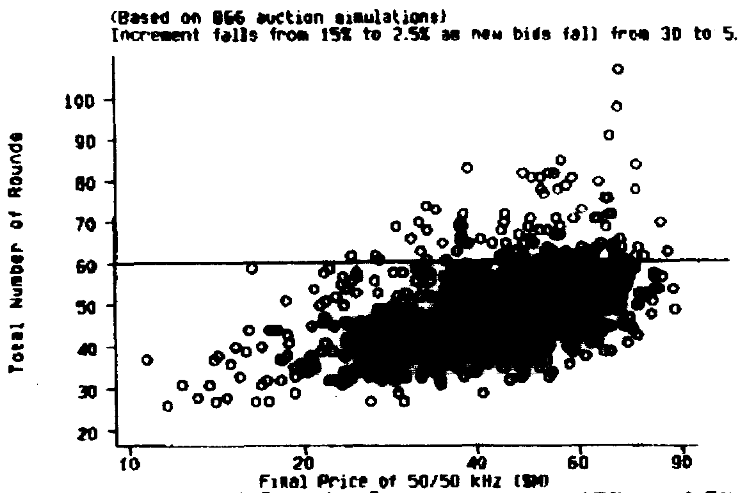

Figure 3. Number of Rounds; Increment from 15% to 2.5%

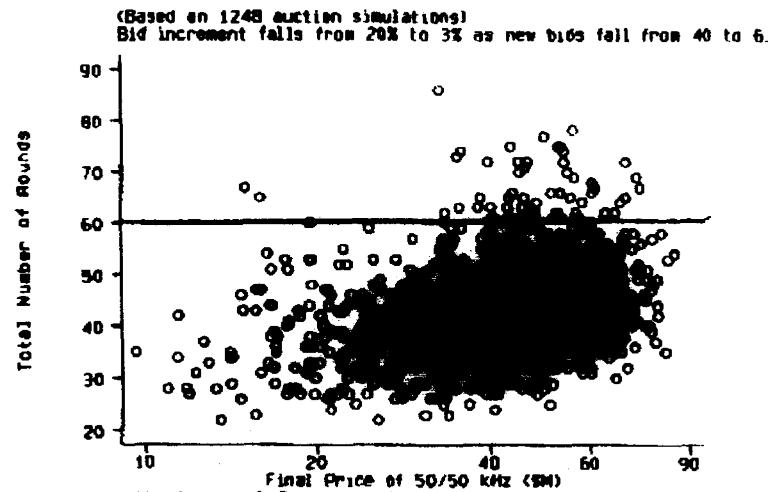

Figure 4. Number of Rounds; Increment from 20% to 3%